

REMARKS

Claims 1-10 are pending in the application.

Figures 1A and 1B are amended to recite "Figure 1A Related Art" and "Figure 1B Related Art" as indicated in the annotated sheet and in the replacement sheet.

Entry of the Amendment and replacement drawing sheets along with reconsideration and review of the claims on the merits are respectfully requested.

Formal Matters

Applicants appreciate that the Examiner has acknowledged the claim for foreign priority and the receipt of the priority document, and also appreciate that the Examiner has reviewed and considered the references cited in the Information Disclosure Statement filed January 30, 2004.

Election/Restriction

Applicants affirm the election without traverse to prosecute the invention of Group 1, Claims 1-8 drawn to a semiconductor device.

Method Claims 9-10 are withdrawn from consideration by the Examiner.

Allowable Subject Matter

Applicants appreciate the Examiner's indication that Claims 4-5 and 7-8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants submit that in view of the following remarks, Claims 1-8 are patentable as written. Reconsideration and allowance of pending Claims 1-8 are respectfully requested.

The Examiner's Objection to the Drawings

Applicants respond to the Examiner's objection to the drawings by labeling Figures 1A and 1B as "Related Art".

Accordingly, Applicants respectfully request reconsideration and withdrawal of the objection to the drawings.

Claim Rejections Under 35 U.S.C. § 103

Claims 1 to 8 are rejected under 35 U.S.C. §103(a) as assertedly being unpatentable over Van Cleemput et al. (U.S. Patent No. 6,576,345) in view of Applicants' admitted prior art (hereinafter AAPR).

With respect to claim 1, the Examiner cites Van Cleemput as disclosing a semiconductor device, comprising a semiconductor substrate and a low dielectric constant film constituted essentially of a ladder-type hydrogen siloxane provided on a semiconductor substrate.

The Examiner recognizes that Van Cleemput does not specifically describe a protection film provided on said low dielectric constant film. However, the Examiner cites Applicants' disclosure in figures 1A-B and the specification at pages 2-3 which describes a protection film provided on said low dielectric constant film to a barrier film (5) to provide an inert interface isolation and to prevent damage in subsequent processes like high temperatures

and etching.

The Examiner asserts that it would have been obvious to one of ordinary skill in the art to include Applicants' disclosure of a barrier film in Van Cleemput's device to provide an inert interface isolation and to prevent damage in subsequent processes like high temperatures and etching.

Applicants respectfully traverse the rejection.

Applicants submit that even if the combination of Van Cleemput with Applicants' disclosure were proper, which Applicants respectfully deny, the combination of these references would still fail to render obvious the present invention.

In each of Applicants' embodiments, the present invention provides for a semiconductor device comprising a semiconductor substrate, a low dielectric constant film constituted essentially of a *ladder-type hydrogen siloxane* formed on the semiconductor substrate, a protection film provided on the low dielectric constant film, and a metal interconnect formed in the low dielectric constant film and the protection film (see page 4, lines 4-10). Thus, Applicants specify that the low dielectric constant film (or low-k film) must be a "ladder-type hydrogen siloxane".

Applicants discovered that the structure of the present invention, including the use of a ladder-type hydrogen siloxane, provides the benefits of reducing interconnect capacitance, while also upgrading erosion resistance. (see page 4, lines 11-19; and Fig. 11). As one example, a ladder-type hydrogen siloxane can be L-OxTM.

On the other hand, Van Cleemput is directed to low k dielectric films formed from *caged-siloxane precursors* which are linked in such a way as to form dielectric layers, using supercritical fluids to dissolve and deliver the caged-siloxane precursors and to remove reagents and byproducts (see Abstract). Van Cleemput emphasizes the use of caged siloxane moieties in its embodiments (see, for example, col. 3, lines 27-38; col. 4, lines 36-44; col. 5, lines 30-39; and col. 8, lines 24-46). A caged siloxane moiety is defined in Van Cleemput as a subunit of a caged siloxane precursor, that has as its molecular structure silicon atoms bridged to one another via oxygen atoms in such an arrangement so as to form a polyhedron, bowl-like, or any three dimensional form having an interior and exterior space associated with it (col. 8, lines 28-33; see also Fig. 5). Thus, Van Cleemput's disclosure of caged siloxane moieties fails to render obvious Applicants' invention.

Further, Van Cleemput actually teaches away from achieving Applicants' invention. Although Van Cleemput mentions "two-dimensional ladder-type" silsesquioxanes (siloxane) in the Background of the Invention section, such disclosure is coupled with the recognition that such silsesquioxanes are often brittle and the high temperature curing raises the dielectric constant in the final product (col. 2, lines 15-36). Thus, taken altogether, such disclosure in Van Cleemput clearly teaches against the use of a ladder-type hydrogen siloxane in favor of the three-dimensional caged-siloxane precursors.

On the other hand, Applicants describe the drawbacks of using a caged-siloxane film, such as a conventionally known HSQ film having a cage-type molecular structure. In the Description of the Related Art section, Applicants describe that the HSQ film, when employed as

an interconnect insulating film, lacks good chemical resistance and mechanical strength such that the HSQ film is largely scraped off during a CMP process, leaving behind an extensive erosion region (see page 3, lines 6-18; Fig. 1B and Fig. 15).

Applicants submit that Van Cleemput fails to disclose or teach at least the ladder-type hydrogen siloxane of the present invention. Thus, it would not have been obvious to require the use of a low dielectric constant film constituted essentially of a ladder-type hydrogen siloxane formed on the semiconductor substrate and a protection film provided on the low dielectric constant film, in the present invention.


Further, regarding the Examiner's characterization of Applicants' Admitted Prior Art (AAPR), Applicants submit that Figures 1A and 1B do not disclose a "protection film" of the present invention. A barrier film (5) of Figures 1A and 1B would not be structurally equivalent to "a protection film provided on said low dielectric constant film", as recited in present Claim 1. The barrier film (5) is constituted of Ta, TaN, Ti, TiN or layers thereof (see page 2, lines 15-17). On the other hand, Applicants describe that the protection film of the present invention may be constituted essentially of a silicon oxide film (see page 6, lines 7-11). In one embodiment of the present invention of Figure 4, a first protection film (208) and a second protection film (217) are made of a SiO₂ film (see page 17, line 1 and lines 18-19). The protection films of the present invention are structurally different in physical location and purpose from the barrier film (5) of Figures 1A and 1B and barrier films (208, 226 and 220) of Figure 4.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a).

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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AMENDMENTS TO THE DRAWINGS

Please amend Figures 1A and 1B to recite “Figure 1A Related Art” and “Figure 1B Related Art” as indicated in the annotated sheet and in the replacement sheet of drawings.

Attachment: Annotated Sheet
Replacement Sheet

FIG. 1A Related Art

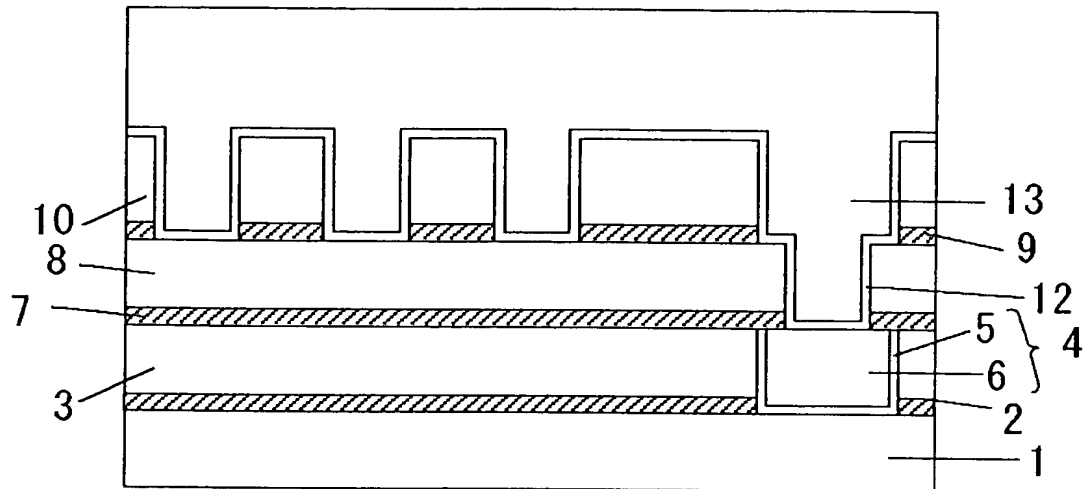


FIG. 1B Related Art

